

# ***Land Data Assimilation at NCEP/EMC***

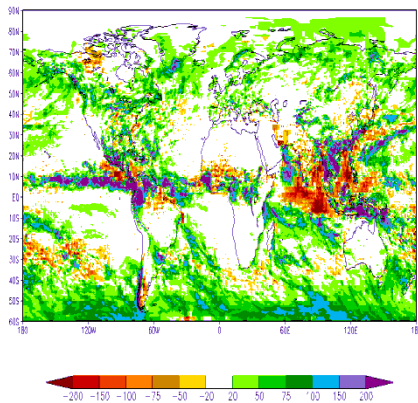
***Michael Ek and Jesse Meng***

## **Improving the Land Component in the next NCEP Reanalysis**

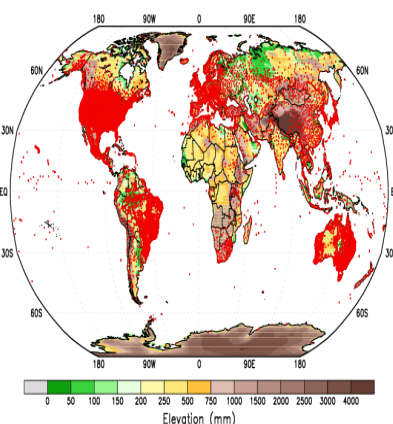
- Upgraded Noah land surface model.
- Higher-resolution land data sets, i.e. vegetation, soils, vegetation phenology (near-realtime), etc.
- Improved forcing, especially precipitation.
- Land data assimilation (e.g. snow, soil moisture).
- Thorough land model spin-up and enhanced downscaling procedures.
- Include river routing to complete water cycle.
- Extends land-atmosphere coupling to include ocean.
- Test improved GLDAS in Climate Forecast System.

# ***Global Land Data Assimilation System (GLDAS)***

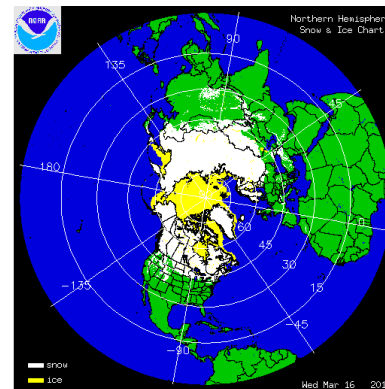
- **GLDAS** (runs Noah land surface model (LSM) under NASA/Land Information System (LIS) forced with CFSv2/GDAS atmospheric data assimilation output & “blended” precipitation in a semi-coupled mode).
- **Blended precipitation** via satellite (CPC/CMAP; heaviest weight in tropics--satellite observations more accurate & surface gauges sparse), gauge (heaviest in mid-latitudes where gauge density highest) & GDAS (modeled; high latitude--gauges sparse, satellite obs lack accuracy).
- **Snow** cycled in CFSv2/**GLDAS** if model within 0.5x to 2.0x observed value (IMS snow cover & AFWA snow depth products), else adjusted to 0.5 or 2.0 of observed value.



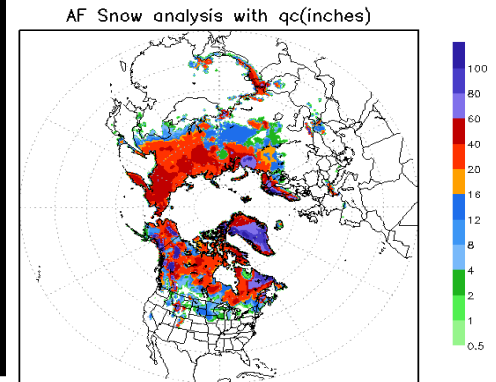
*GDAS-CMAP precip*



*Gauge locations*



*IMS snow cover*

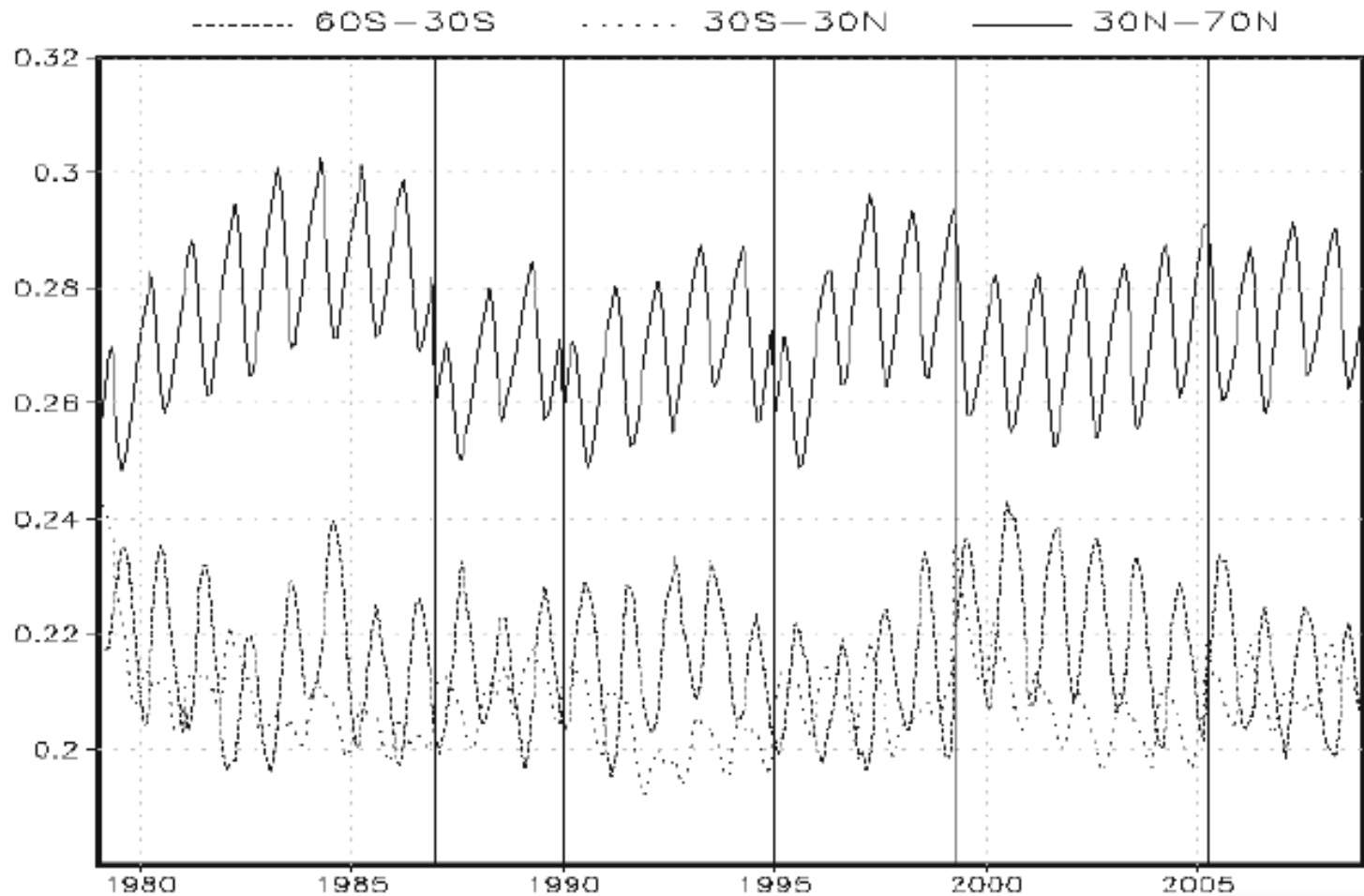


*AFWA snow depth*

# ***GLDAS Replay***

<b>Motivation</b>	CFSR was executed in 6 streams Discontinuity at stream boundaries
<b>Solution</b>	Single-Stream GLDAS (1979-realtime)
<b>Configuration</b>	Same as CFSR (T382)
<b>Forcing</b>	CFSR surface forcing Blended precip forcing
<b>Spin up</b>	15 years

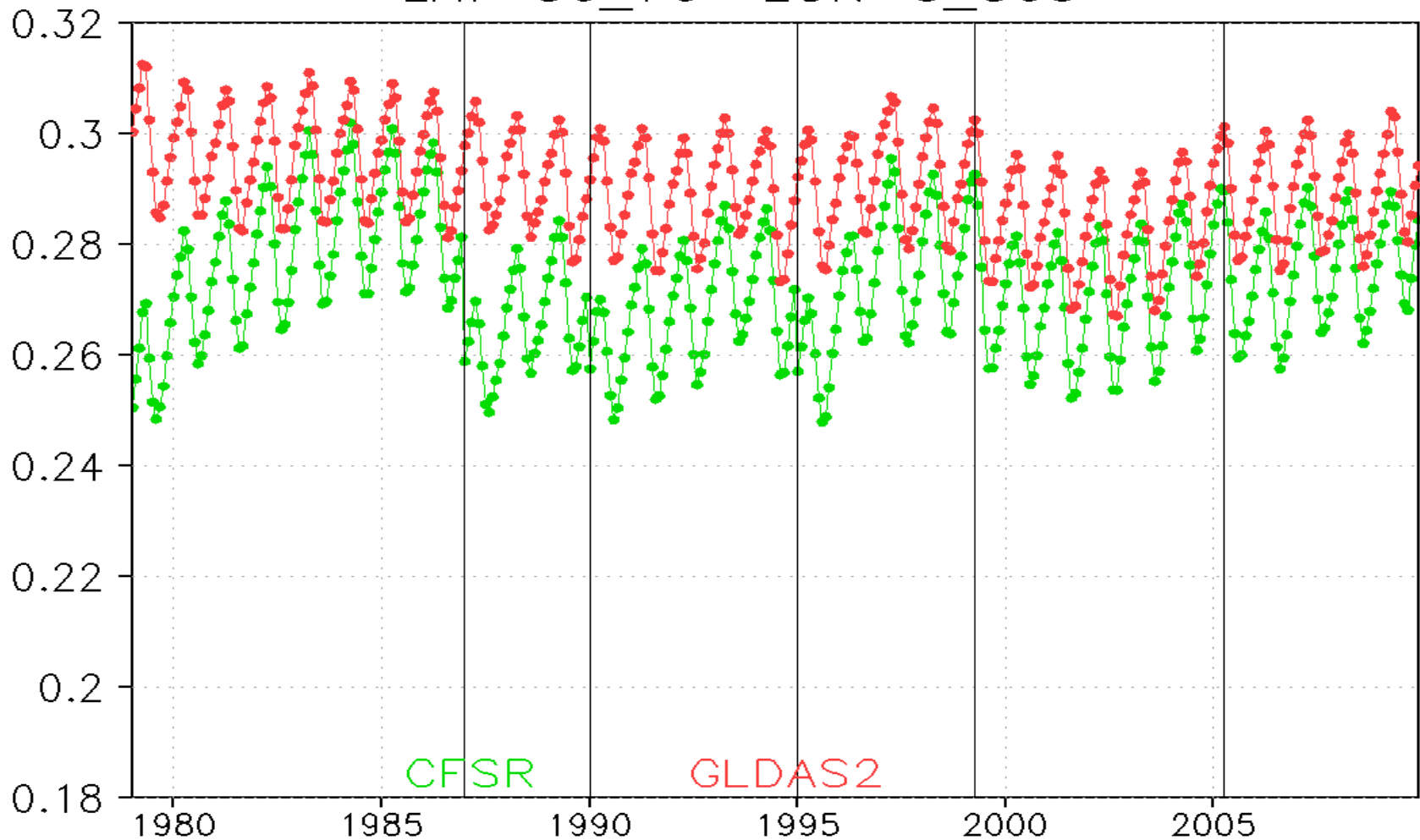
# ***Soil Moisture Trends in CFSR Streams?***



Courtesy of  
Arun Kumar

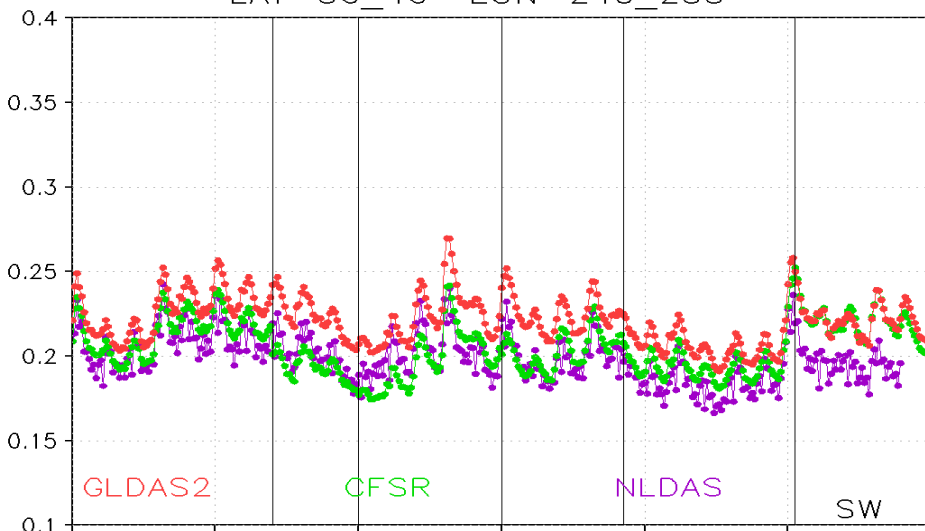
# ***Single-Stream GLDAS2***

0–200cm Soil Moisture  
LAT=30\_70 LON=0\_360

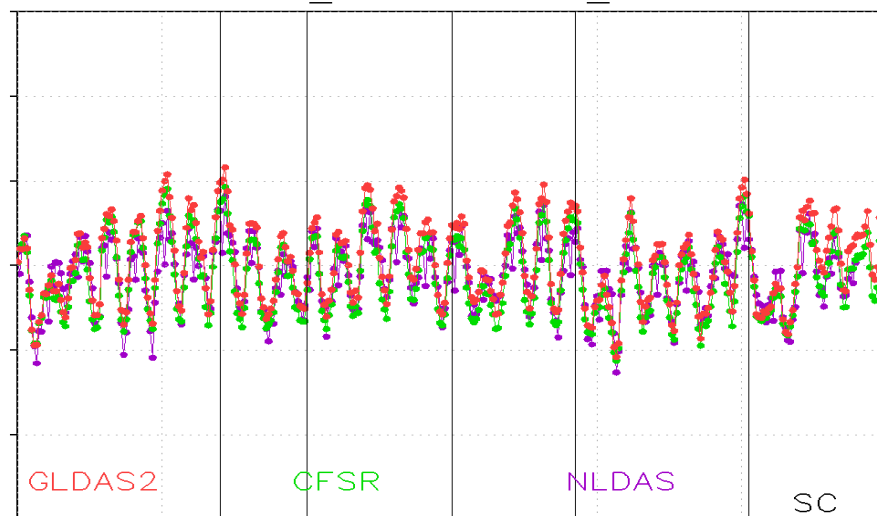


# ***CFSR vs GLDAS2 soil moisture anomaly CONUS Southwest and Southern Plain***

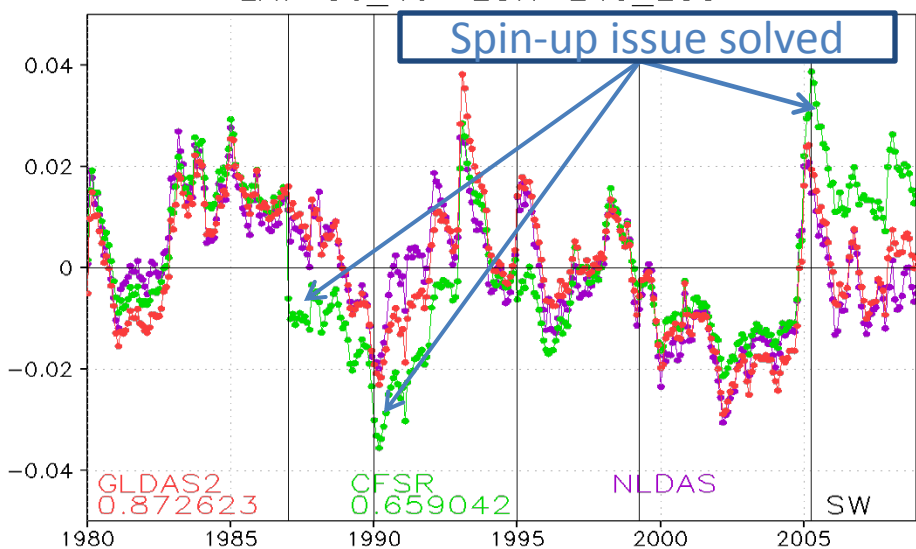
0–200cm Soil Moisture  
LAT=30\_40 LON=240\_255



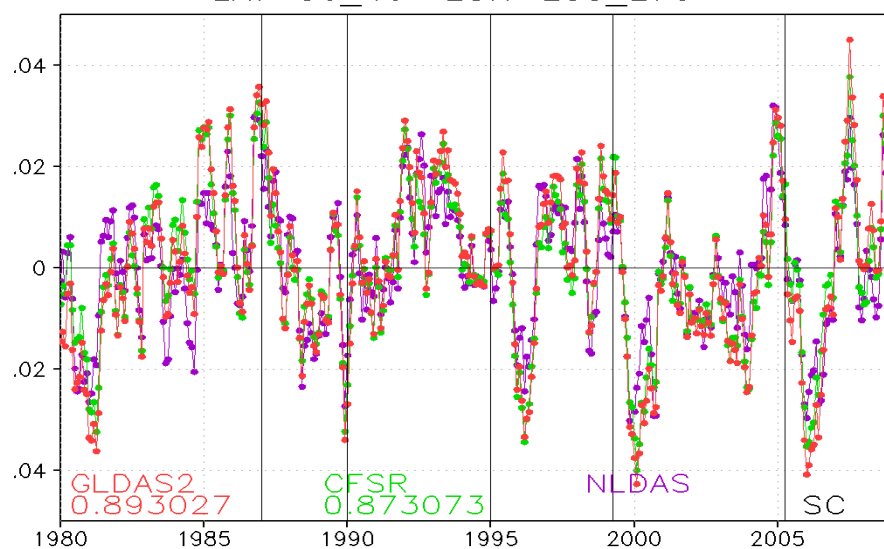
0–200cm Soil Moisture  
LAT=30\_40 LON=255\_270



0–200cm Soil Moisture Anomaly  
LAT=30\_40 LON=240\_255



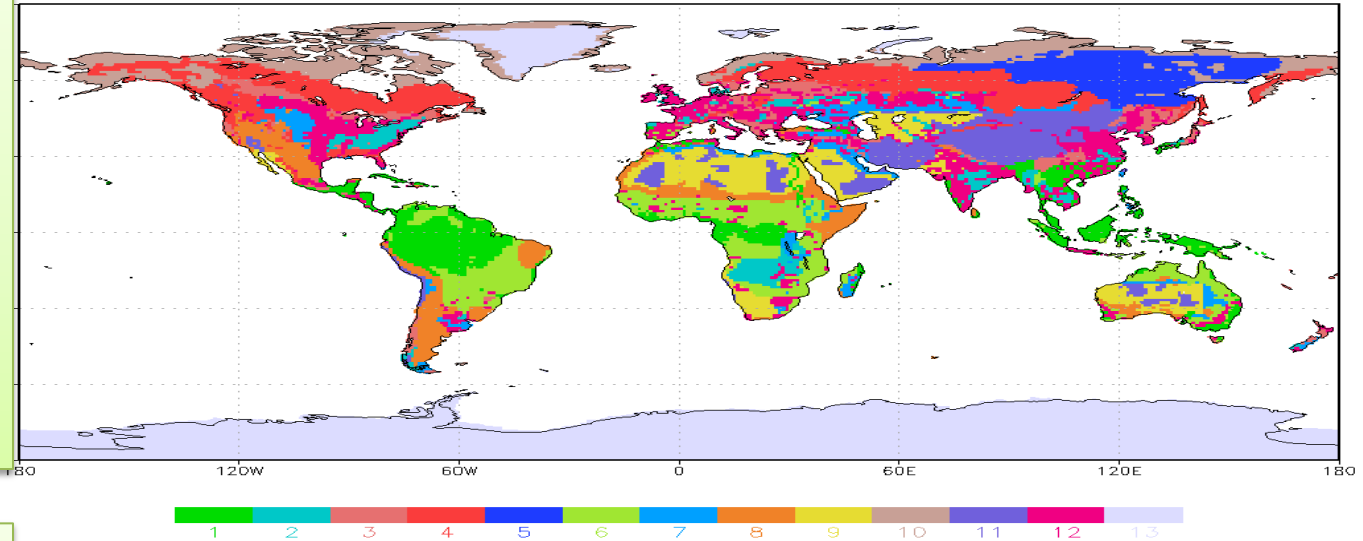
0–200cm Soil Moisture Anomaly  
LAT=30\_40 LON=255\_270



# Vegetation Types: SIB vs IGBP

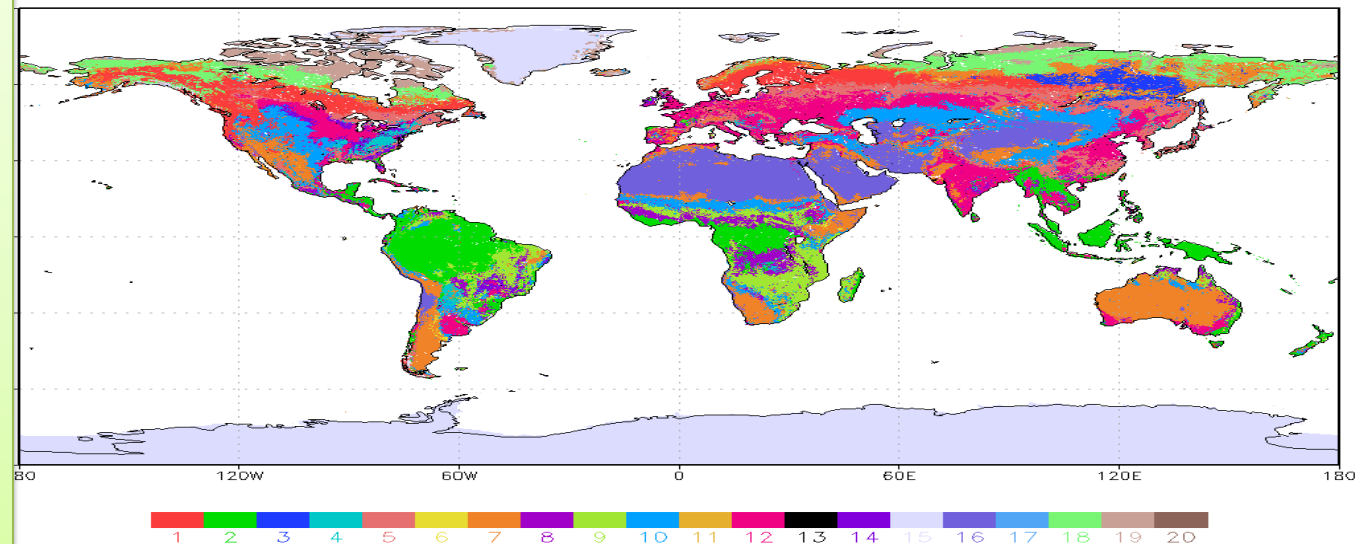
- 1: broadleaf-evergreen trees!
- 2: broadleaf-deciduous trees
- 3: broadleaf and needleleaf trees!
- 4: needleleaf-evergreen trees
- 5: needleleaf-deciduous trees (larch)
- 6: broadleaf trees with groundcover
- 7: groundcover only (perennial)
- 8: broadleaf shrubs with perennial groundcover
- 9: broadleaf shrubs with bare soil
- 10: dwarf trees and shrubs with groundcover (tundra)
- 11: bare soil
- 12: cultivations (the same parameters as for type 7)
- 13: glacial ice

GFS SIB VTYPE T382



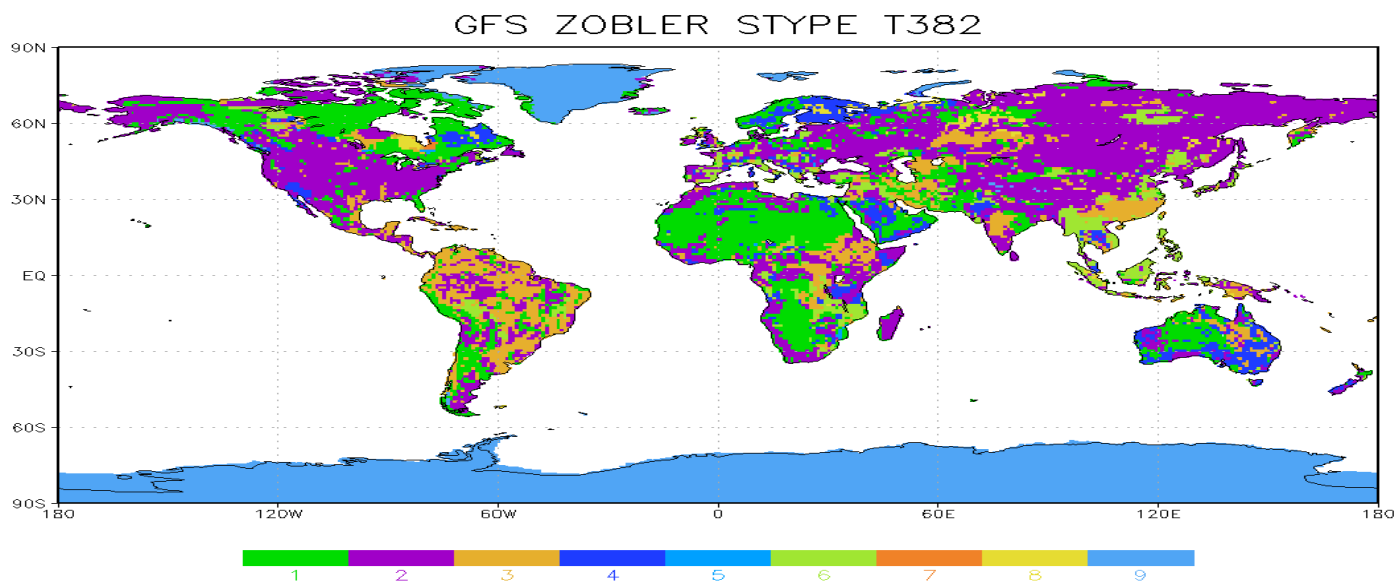
- 1:Evergreen Needleleaf Forest
- 2:Evergreen Broadleaf Forest
- 3:Deciduous Needleleaf Forest
- 4:Deciduous Broadleaf Forest
- 5:Mixed Forests
- 6:Closed Shrublands
- 7:Open Shrublands
- 8:Woody Savannas
- 9:Savannas
- 10:Grasslands
- 11:Permanent wetlands
- 12:Croplands
- 13:Urban and Built-Up
- 14:Cropland/natural vegetation mosaic
- 15:Snow and Ice
- 16:Barren or Sparsely Vegetated
- 17:Water
- 18:Wooded Tundra
- 19:Mixed Tundra
- 20:Bare Ground Tundra

GFS IGBP VTYPE T1534

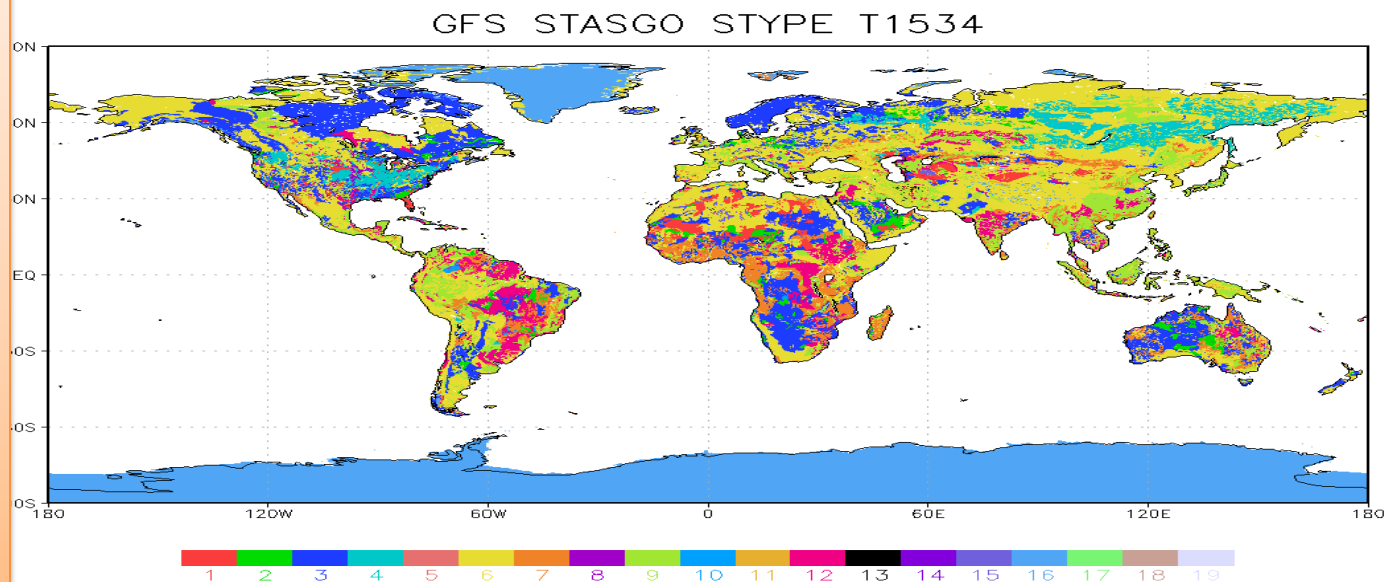


# Soil Types: ZOBLER vs STASGO

- 1 loamy sand
- 2 silty clay loam
- 3 light clay
- 4 sandy loam
- 5 sandy clay
- 6 clay loam
- 7 sandy clay loam
- 8 loam
- 9 loamy sand



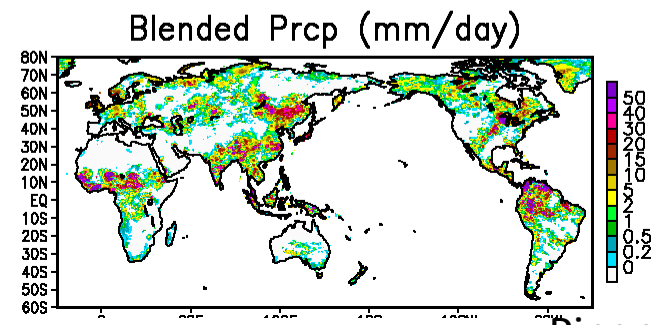
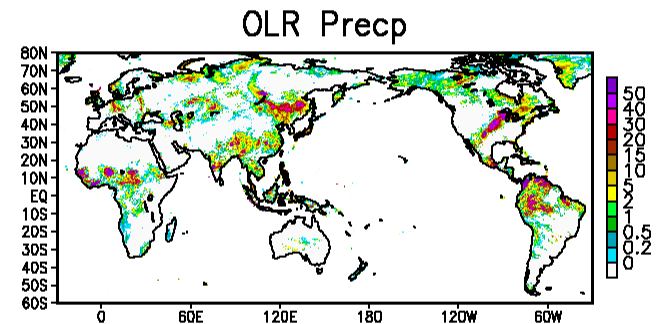
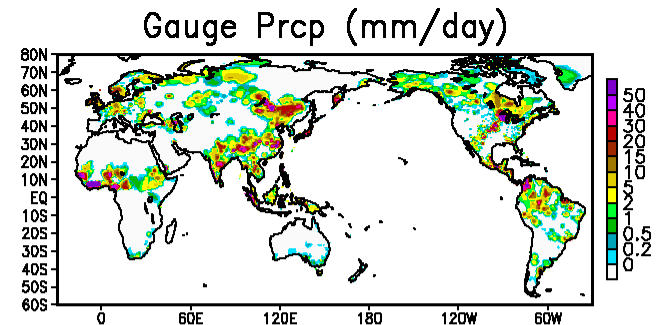
- 1: sand
- 2: loamy sand
- 3: sandy loam
- 4: silt loam
- 5: silt
- 6: loam
- 7: sandy clay loam
- 8: silty clay loam
- 9: clay loam
- 10: sandy clay
- 11: silty clay
- 12: clay
- 13: organic material
- 14: water
- 15: bedrock
- 16: other (land-ice)
- 17: playa
- 18: lava
- 19: white sand





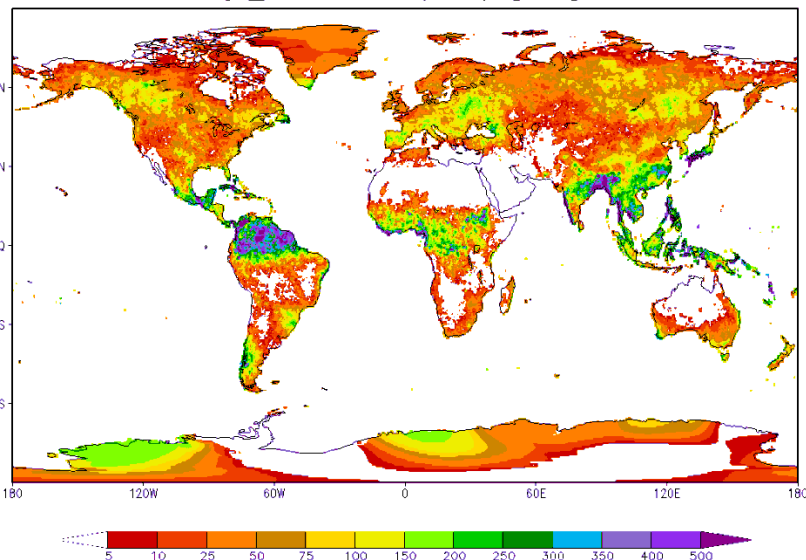
# ***A Gauge-Satellite Blended Analysis of Daily Precipitation for Hydrometeorological Applications***

- 0.25°lat/lon over the global land
- Daily analysis from 1979 to realtime
- Blending information from different sources to overcome shortcomings
- CPC daily gauge analysis adjusted to GPCC monthly gauge data to correct the under-estimation in daily reports
- OLR-based precipitation estimates derived through calibration against CMORPH
- Daily gauge data and OLR precip combined to produce a precipitation analysis with long-term homogeneity and quantitative accuracy
- Right figure: sample for Jul. 15,2010

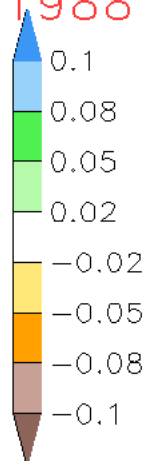
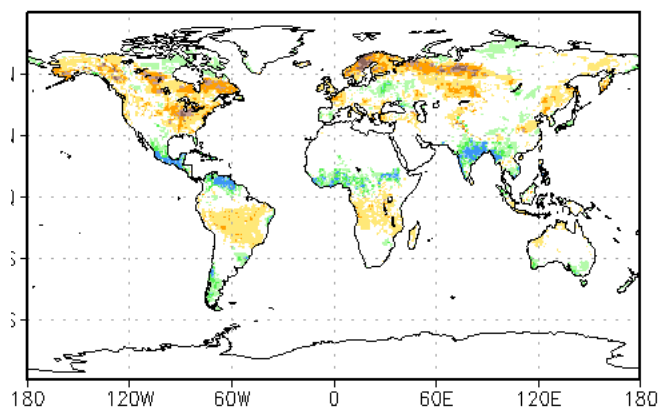


# CPC Gauge-OLR Blended Precip

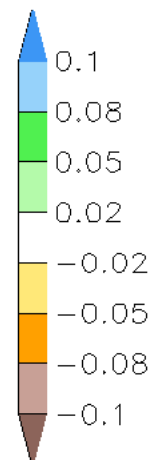
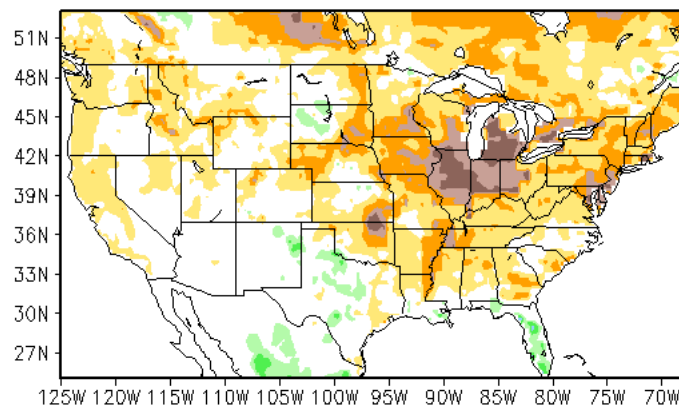
CPC Gauge\_OLR accum precip [mm] Jun1988



smc diff [%] 01Jun1988.01Jul1988



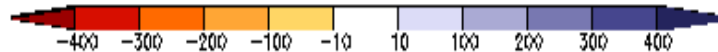
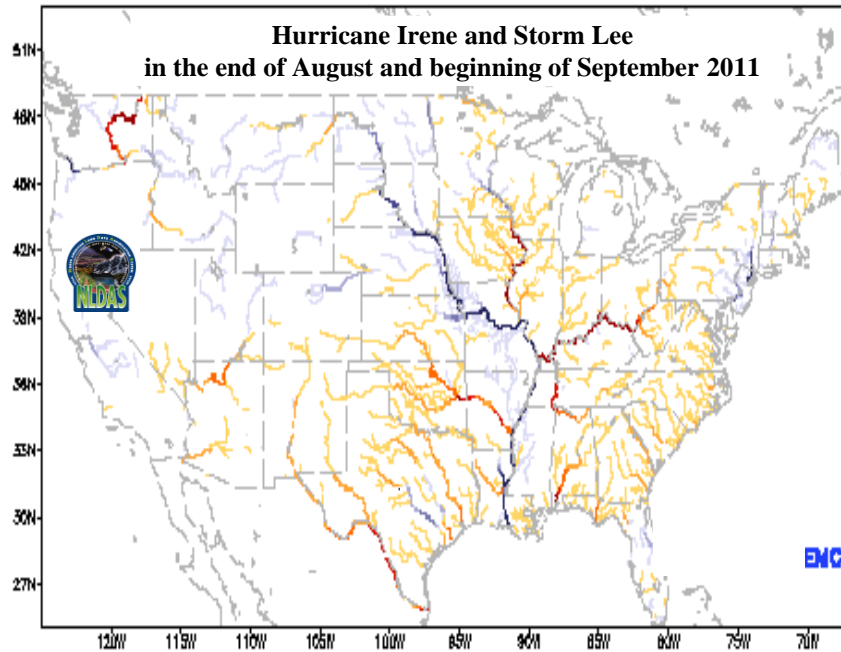
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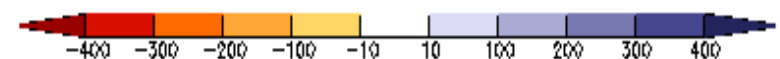
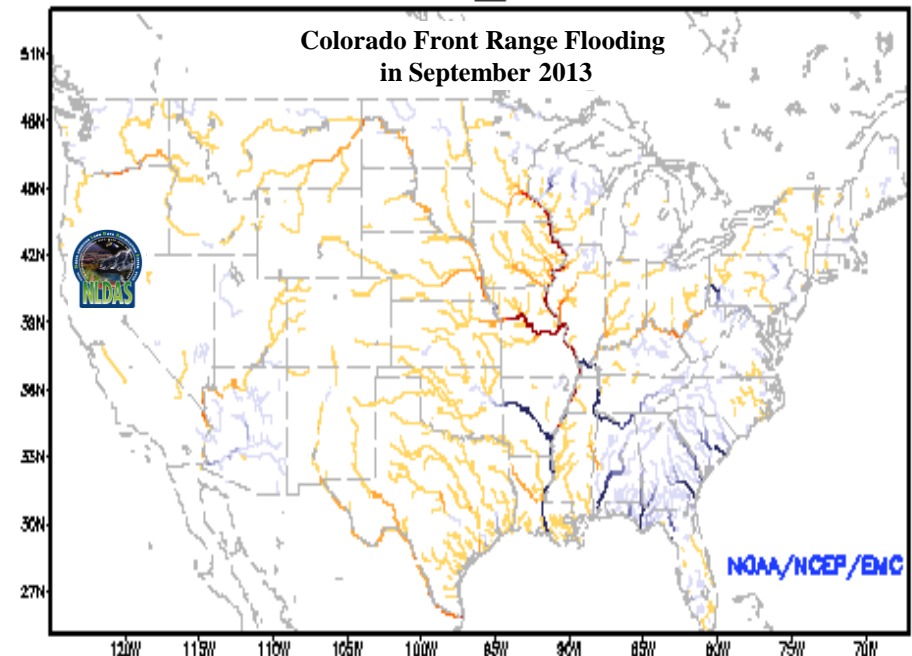
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# ***NLDAS Routed Daily Streamflow Anomaly***

Ensemble-Mean: Current Streamflow Anomaly ( $\text{m}^3/\text{s}$ )  
NCEP NLDAS Products\_\_Valid: AUG 20, 2011



Ensemble-Mean: Current Streamflow Anomaly ( $\text{m}^3/\text{s}$ )  
NCEP NLDAS Products\_\_Valid: SEP 01, 2013



# ***Improving the Land Surface Component in the next NCEP Reanalysis***

- An improved GLDAS, with upgraded Noah land model, will ***Improve Connection between Reanalysis System Components: land, atmosphere & ocean,*** with extension to an upgraded Climate Forecast System.